

**BOTETOURT COUNTY  
STANDARD SPECIFICATIONS  
WASTEWATER PUMPING STATIONS AND FORCE MAINS**

**SECTION 300.0 GENERAL**

In situations where gravity flow is not feasible, the County will consider the installation of a wastewater pumping station and a force main. In addition to meeting the minimum state standards, certain factors must be addressed by the developer for the project for consideration by the County of Botetourt. The factors include:

1. Determine the volume and characteristics of the wastewater flow that would be generated by the total natural drainage basin based upon the existing zoning.
2. Evaluate the capacity of the receiving sewer main at the point of discharge and downstream to determine that the existing gravity main line could handle the transferred sewer flow.
3. Perform a cost analysis of the pumping versus gravity alternative to demonstrate that gravity service is not feasible. The estimated installed construction cost of the gravity alternative (excluding easement acquisition and engineering) must not be less than 3.5 times more costly than the pumping station alternative in order for the County to allow a pumping station.

The above information shall be furnished to the Department of Public Works for consideration. The Public Works Manager, in collaboration with the County Administrator and the County Engineer shall determine whether a pumping station will be permitted.

**SECTION 300.1 DESIGN**

**A. General Requirements:**

Site or subdivision plans which propose a wastewater pumping station shall show in summary form the number of lots or units served, the off-site drainage area and zoning, the average daily flow, peak daily flow, and rated capacity of pumps at a specified total dynamic head.

Pump stations must be of the following type:

- Submersible Pump Station with guide rail pump removal system. All stations shall have a minimum of two (2) pumps of equal capacity,

and shall be capable of handling flows in excess of the expected peak flow.

- Self Priming Centrifugal Pump Station with self priming pumps. All stations shall have a minimum of two (2) pumps of equal capacity, and shall be capable of handling flows in excess of the expected peak flow.

Wastewater pumping stations, structure, controls, etc. shall be protected from physical damage by the 100-year flood. Stations shall remain fully operational and accessible during the 25-year flood. The 100-year flood elevation shall be shown on all site plans.

## **B. Sewage Pump Stations**

1. Sewage pump stations must conform to the following:
  - a) All pump stations shall be located on property deeded to the County. Botetourt County is not responsible for any land acquisition or easements that may be necessary in conjunction with pumping stations, accesses, and force mains.
  - b) The design criteria and equipment specifications must meet the requirements of this standard and the Virginia Department of Health.
  - c) The design calculations for the sewage pump station and force main shall be submitted for review. This design shall address:
    - (1) Design flows from the subdivision and ultimate sewershed
    - (2) Force main TDH and velocities
    - (3) Pump curve
    - (4) Wetwell size
    - (5) Holding times in wetwell and force main relative to septicity
    - (6) Piping configuration
    - (7) Specifications including electrical
    - (8) Operating conditions and setting of pump station between initial and ultimate flows
  - d) An on-site generator shall be provided.
  - e) The entire facility, to include the building lot on which the station is located, must be dedicated at no cost to the County.

- f) All materials must be new and unused.
- g) All pump stations shall be designed with a minimum of two pumps and be controlled by float switches. Pump controllers shall include provisions for automatic alternation plus backup control of pumps.
- h) Sewage pumping stations constructed in the County shall be designed to meet Class I reliability criteria as established by the Commonwealth of Virginia Sewerage Regulations.

Pumping stations should have a minimum 100-foot limited use zone surrounding the pump station.

- 2. All sewage pump stations shall have an entrance ladder not subject to corrosion and properly aligned with hatch for access.
- 3. Pumping stations shall have an alarm system with light and battery backup. The alarm system shall monitor power failure, running on backup power, failure to pump, high wet well level, and low level alarm. An automatic dialing mechanism is also required.
- 4. Gate valves and check valves shall be installed on force main outside of pump station in valve boxes. An adjustable trench adapter shall be used when valve is over 5' deep.
- 5. Pump stations using submersible pumps shall have provisions for pumps to slide freely on guide rails to allow for easy removal and installation. Guide rail bracing shall be provided at the midpoint of each ten-foot length of guide rails.
- 6. Wet well platforms shall be required for submersible wet wells 10 feet deep or greater.
- 7. Stations should be designed to not utilize long stem valves if at all possible.
- 8. Float switches shall be installed to operate free of the pumps and guide rails.
- 9. Operations and maintenance manuals and shop drawings shall be submitted for all electrical and mechanical equipment including complete manufacturer's parts lists and wiring diagrams.
- 10. Electrical Requirements:
  - a) Three-phase power should be provided for all sewage pump stations with pump motors larger than 3 horsepower. Where 3 phase is available, all pumps shall be 3 phase.

- b) Three phase pumps shall have phase protection on individual phases. Three phase pumps shall have an individual poly-phase starter.
- c) All pumps shall be controlled by starters and have individual HOA switches with test and run lights.
- d) Starters shall be sized one size larger than horsepower required. Heaters shall be sized for actual current load.
- e) Leakage sensors for indication and protection of fluids in stator housing shall be installed.
- f) An hour run meter shall be provided for each pump motor.
- g) All control circuits shall be a maximum of 120 volts.
- h) Electrical service shall be provided with secondary surge arresters.
- i) All electrical wiring shall be copper, placed in conduit, and have markers at all wire terminations.
- j) Electrical panel shall have a minimum of 12 circuits.
- k) At least one 20 amp GFI circuit shall be provided.
- l) A non-automatic transfer switch shall be installed on load side of service disconnect. Switch shall be rated same as or higher than service disconnect.
- m) All wiring, electrical equipment and installation shall meet requirements of current National Electrical Code. All areas to be considered wet locations.
- n) Electrical junction boxes and other accessories shall be easily accessible
- o) All wastewater pumping stations shall be equipped with an automatic alternate power source. Alternate power sources include on-site standby power, or dual power feed from separate electric substations.

**B. Site Work:**

The site work shall be generally level graded to remove run-off from site in a non-erosive manner. Drainage swales shall be provided to direct drainage away from the site.

Concrete or asphalt pavement, crushed stone, or other suitable materials shall stabilize the site.

The site area shall be secured by a 6-foot high chain link fence topped with three (3) strands of barb wire. Fence products shall be only new materials using hot dipped galvanized iron or steel components and aluminum coated fabric after fabrication. Gates shall permit 180 degree opening and located so as to provide vehicle accessibility to lift the pumping units. There shall be a minimum gate opening of twelve (12) feet to facilitate truck access and at least one "walk through" gate (min. 4' width). An all-weather access road (stone base, 6" VDOT 21A compacted with prime and seal surface) shall be provided to the pumping station site. The road shall have a minimum travelway of 10 feet in width, with 2-foot wide shoulders and side ditches. The maximum vertical roadway grade shall be 10 percent.

The site shall have adequate turn-around areas for service vehicles.

A 150-watt high-pressure sodium light fixture shall be strategically located upon a lighting standard or timber utility pole. The light fixture shall be operated by a circuit breaker in the main control panel; or if a timber pole is used, a pole mounted disconnect switch shall be installed. Mounting height shall be 20 feet (minimum) above finished grade.

**C. Piping and Valves:**

Suction and discharge piping shall be ductile iron flanged pipe designed and manufactured per AWWA Specifications C150 and C151.

A check valve and a plug valve shall be provided for the discharge line of each pump. Valves shall be rated for 100 psi in excess of working pressure, and shall have full port openings equal to 100% of the adjacent pipe area. Check valves and shutoff valves shall be mounted in the horizontal position.

All piping, couplings, fittings, valves, etc. shall be Class 125 flanges meeting ANSI B16.1 Specifications, unless class 250 flanges are required for high head installations.

Piping shall be designed to provide adequate thrust restraint during pump operating cycle.

**D. Structural:**

All pump station structures shall be designed to withstand the hydrostatic forces that they will be subjected to, *including uplift*.

Cover slabs for wet well and valve vaults shall be reinforced concrete with integral cast in place access hatch covers. Cover slabs shall be reinforced as per ACI Code and specially reinforced around openings. Access covers

shall be sized and positioned according to pump unit installation. Access covers and frames for pumps shall be vehicular load bearing, double leaf aluminum diamond pattern floor hatch of ¼ inch (minimum) thickness. Each leaf shall open 90 degrees and be attached to the frame by steel hinges. The door shall have a locking hasp and vinyl grip handle to release door for closing.

A valve vault shall be required for submersible pump stations. The valve vault shall consist of a precast manhole base section, or a cast-in-place custom built section, or a precast rectangular structure all complete with drain, access ladder or steps, and access cover cast in the structure roof.

The valve vault drain shall be connected to the wet well. The drain shall include a "P" trap.

Wet well structures must be precast concrete construction. Precast manhole units shall conform to the requirements of ASTM C478, with watertight joints per ASTM C443.

**E. Wet Well Vents**

All wet well structures shall have a 4-inch diameter ductile iron pipe goose necked screened vent to allow the escape of gases and to enable air intake during pump down.

**F. Alarm Dialer**

On all wastewater pumping station installations, an automatic alarm dialer shall be furnished and installed. The dialer unit shall conform to the specifications presented herein under the "Alarm Dialer System" section.

**G. Water Service Line**

Each pumping station shall have an individual potable metered water supply service line consisting of a ¾" service line with approved backflow preventer and terminating at the pump station site with a freeze-proof yard hydrant.

**H. Flow Measurement**

Each pumping station shall have flow measurement devices installed to record instantaneous flow and total flow in gallons.

## **SECTION 300.2 SUBMERSIBLE PUMP STATIONS**

### **A. GENERAL**

All pump stations being placed into service and deeded to the County shall meet the following criteria. Failure to meet these standards will lead to rejection of the station. The owner of said station shall meet these standards. Until they meet these standards the station shall not be put into operation and or accepted by the County.

### **B. PUMPS**

1. The following pumps will be accepted into the Botetourt County system:
  - a. Fairbanks Morse
  - b. Goulds
  - c. Gorman-Rupp
  - d. Hydromatic
  
2. All pumps shall be non-clog type if possible. Whenever a grinder pump is proposed it will be approved on an individual basis. Each station shall be a duplex pump station. The contractor/developer shall also supply to the County a spare pump identical to the pumps located in the sewage pump station at no cost to the County. If a grinder pump is approved two spare pumps shall be provided to the County at no additional cost.

### **C. VOLTAGE**

The voltage for all pump stations having pump motors greater than 3 horse power shall be 3-phase. The use of single-phase power is acceptable on pump stations having pump motors of 3 horsepower of less..

### **D. GUIDE RAIL SYSTEMS**

Each pump shall be installed on a guide rail system. The guide rail system shall allow maintenance personnel to remove the pump without entering the wet well. The guide rails shall be 304 stainless steel or fiberglass. The use of galvanized piping shall not be acceptable. Guide rail bracing shall be provided at the mid-point of each ten feet length of guide rails.

### **E. HARDWARE**

All fasteners, hardware, and accessories in the wet well shall be stainless steel whenever possible. The County shall approve any other materials before installing in the sewage pump station.

#### **F. PIPING**

All intake and discharge piping shall be minimum four-inch diameter unless a grinder pump is specified. All three-inch diameter piping or larger shall be ductile iron or stainless steel. Piping smaller than three-inch diameter shall be SCH 80 PVC. The use of galvanized piping shall not be allowed. Proper pipe supports shall be used in the wet well. Supports for discharge piping shall be every three feet on the discharge pipe.

#### **G. VALVES**

Each pump will have its own check and gate valve. The valves shall be of the same material as the piping. In the case of piping smaller than 3" bronze, brass, or cast iron shall be used.

#### **H. LIFTING CHAINS AND HOIST**

Lifting chains shall be provided and attached to each pump and shall be stainless steel. The use of lifting cables or galvanized materials shall not be acceptable. Each chain shall be placed on a hook made of stainless steel in the wet well or attached to the access hatch with a stainless steel shackle. Provide a winch-type hoist mounted on a post with a cantilevered arm.

#### **I. PUMP POWER CABLES**

All pump cables shall be from the pump to the control panel without any splices. Junction boxes located in the wet well shall not be acceptable.

#### **J. PUMP MECHANICAL SEALS**

All pump seals shall be of the dual mechanical type. The use of lip seals for the secondary seal shall not be acceptable.

#### **K. CONTROL PANEL**

1. Each control panel shall be of the duplex type. The pump supplier shall supply the control panel to ensure unit integrity. The panel

enclosure shall be NEMA 3R painted steel or fiberglass with padlocking hasp.

2. Swing dead front inner doors shall be utilized. All lights and switches for control and indication shall be located on the front inner door. Circuit breakers shall be accessed thru the inner door. All lights shall be replaceable and run off of 115 volt. Alarm lights shall be red. Indication lights shall be amber. Pump run lights shall be green.
3. The flashing alarm light and horn shall be mounted remotely on the outside of the pump house. The alarm light and horn shall be on a separate circuit that is fused. A battery with trickle charger shall power these devices. The battery shall power the alarm for at least 6 hours in the event of a power failure. The alarm horn shall incorporate silence switch mounted on the outside of the control panel. This silence switch shall only silence the alarm horn. The alarm light shall continue to flash until the alarm is cleared manually or corrected itself.
4. Elapsed run-time meters shall be included. One shall be installed for each pump on the inner door.
5. A phase monitor shall be installed on the incoming power of the control panel to prevent phase reversal and single phasing of the pumps. If single phasing happens than the power failure alarm shall be activated.
6. Control Sequence – On rising liquid level in the wet well, a float switch shall initiate operation of the lead pump at the elevation indicated on the DRAWINGS. Should the liquid level continue to rise, a second float switch would initiate operation of the Lag Pump. The pump(s) would continue to operate until the liquid level recedes to the point where a third float switch would stop the pumps.

The two (2) pumps shall automatically alternate between the “lead” and “lag” positions by means of an electric alternator in the panel. Should the liquid level continue to rise above the “Lag Pump On” level, a fourth float switch would activate the alarm circuit.

7. Control Panel – The duplex pump control panel shall be furnished by the Pump Manufacturer, completely pre-wired, factory assembled, tested and ready for service. Where possible, pump controls shall be housed in a single panel. For outside installations at a submersible stations, the panel shall be NEMA 3 door-in-door enclosure, fully gasketed with drip cap. The panel shall be suitable for mounting on

the panel board as indicated on the DRAWINGS. The panel shall contain the following elements:

- a) Separate Manual Disconnect for each pump with 2-pole adjustable overload protection for each phase
- b) Magnetic starter for each pump motor with all leg quick trip ambient compensated overload protection for each motor. Overloads are to have an auxiliary contact for automatic dialer
- c) Hands-Off-Auto selector switch for each pump
- d) Automatic Electric Alternator
- e) Circuit Breaker for Control Circuit
- f) Motor thermal protection – Motor control circuit is to shut down in high temperature occurs. Manual resets to be provided
- g) Float control system for duplex pumps and alarm system
- h) Control Disconnect
- i) Seal failure light for each pump and contact closure for automatic dialer (submersible installations only)
- j) High temperature light for each pump and contact closure for automatic dialer (submersible installations only)
- k) Running light for each pump
- l) Non-resettable, elapsed time meter for each pump, reading in tenths of hours. Capacity – 100,000 hours
- m) High level alarm light with Red Globe and contact closure for automatic dialer (Remote mounting for “package” pump station where panel is inside pump compartment)
- n) Audible alarm
- o) Back-up battery (12v) for alarm
- p) All necessary internal wiring, relays, etc. to provide the operation as described

## **L. DISCONNECTS**

Each pump shall be equipped with a service rated disconnect. This device shall be placed before the control panel. It shall also be placed before the

automatic transfer switch. This will allow maintenance personnel the ability to work on the automatic transfer switch or the control panel in a safe manner. This device shall be housed in a NEMA 3R painted steel or fiberglass enclosure with locking hasp. It shall also have the ability to be locked in the off or on position.

#### **M. PADLOCKS**

1. Hasps to receive padlocks shall be placed on each of the following:
  - a. Wet well access hatch
  - b. Disconnect
  - c. Automatic transfer switch
  - d. Control panel
  - e. Remote monitoring device
2. The County will provide padlocks when the pump station has been accepted into the system. Contractor shall provide padlocks that are required to maintain security of the pump station until County acceptance.

#### **N. ACCESS HATCHES**

All access hatches shall be made of aluminum. They shall have bituminous coating. A spring arm assist on each hatch is needed. The hatch shall also be rated to H2O loading. Hatches for the wet well shall be sized to ensure the pumps can be pulled out easily without any unusual maneuvers.

#### **O. BYPASS PUMP CONNECTION**

A bypass pump connection shall be supplied for each pump station. This shall be located after the valve vault. It will consist of two gate valves and one check valve. It shall be equipped with a cam lock quick connection fitting.

**P. SUCTION SHOE**

A suction shoe shall be placed in the wet well to facilitate bypass emergency pumping without opening the access hatch. An inspection access hatch twelve-inches square will also be installed on the wet well that will allow floats to be dropped for the bypass pump system. The suction shoe shall have a cam lock quick connection on it.

**Q. BYPASS PUMP SYSTEM**

Each pump station shall be supplied with a bypass pump system. This pump shall be a self-priming centrifugal pump mounted on a trailer and engine driven. It shall meet the pumping conditions for the pump station. A 12-volt DC control system shall be supplied that runs off mercury floats that will start and stop the pump. Suction and discharge hoses shall be supplied with this self-priming centrifugal pump to provide connection between the suction shoe and the emergency bypass pump connection.

**R. PUMP HOUSE**

1. Each pump station shall have a pump house. This pump house will house the control panel, disconnect, transfer switch, and any other electrical devices. The pump house shall be heated with a thermostatically controlled electric heater to prevent freezing of the piping. Power-actuated louvers connect to a motorized exhaust fan will also be installed to circulate air in warm weather. The exhaust fan shall be controlled by an adjustable thermostat, and shall provide a minimum of four air exchanges per hour.
2. The pump house shall be concrete engineered building with a brick stencil finish or stone finish. The building size shall be as necessary for proper operation, with a minimum size of 144 square feet. The door opening shall be double doors made of steel or aluminum.
3. The pump house shall have two overhead lights and 3 duplex GFI receptacles. They will be connected to a panel box. A transformer will be supplied if needed to supply power for these accessories.

**S. Shop Drawings:**

Prior to purchase of submersible pumping equipment, the Contractor shall submit not less than four (4) sets of data to the Department of Public Works for approval,

including pump performance data, control panel wiring diagrams and other material required to determine compliance with these specifications.

**T. Operation and Maintenance Manuals:**

Three (3) complete O & M Manuals as well as three (3) complete sets of manufacturers service manuals, shall be furnished to the Department of Public Works covering all equipment furnished – pumps, motors, controls, alarm dialer, etc. For pump stations, these manuals will no longer be reviewed by DEQ. However, owners of pump stations are required to maintain an up to date O&M manual for their pump station and to maintain and operate the station in accordance with that manual. Refer to the DEQ Instructions to Applicants for a Certificate to Operate for a list of requirements to be included in the O&M manual.

**U. Spare Parts:**

At the time that the pumping station is accepted for operation and maintenance by the County of Botetourt, certain spare parts shall be furnished, consisting of any items which may be recommended by the equipment manufacturer and listed in the O & M Manual.

**V. Warranty:**

The manufacturers of the pumping equipment, control panel, and dialer shall warrant to the County of Botetourt that the equipment which is supplied shall be free of defect in materials and workmanship for a period of 12 months following acceptance of the facility for maintenance by the County. The warranty shall name the County as warrantee and shall be delivered to the Department of Public Works at the time of final acceptance.

**W. Start-up Training**

At least two (2) days of on-site start-up training will be provided to operations staff by the manufacturers' representative. The representative will also certify that all equipment is operating per specifications.

**SECTION 300.3 ALARM DIALER SYSTEM**

**B. General:**

Each pump station shall be equipped with an automatic monitoring and alarm dialer system.

It shall be the responsibility of the Developer/Contractor to install the necessary switches, contacts, relays, etc. and associated wiring required to monitor and report the alarm conditions as noted herein. The Contractor shall also be

responsible for arranging for the telephone service and installation of the required phone jack.

### **C. Functional Description:**

The Alarm Dialer System shall be completely self-contained and fully automatic. The system shall monitor a minimum of four (4) independent alarm conditions plus power failure. (Common alarm conditions shall be wired in series to limit the number of independent conditions.) Alarm status shall be indicated by the operation of any single or multiple set of normally open or closed isolated contact. Multiple faults shall be reported in one (1) call if necessary.

The system shall be connected into the telephone line network through a self contained FCC approved coupler and shall plug into a standard jack supplied with the telephone line. A regular telephone line shall be used with the system.

Upon operation of any alarm contact, the system shall address the telephone line, wait for a dial tone, and begin dialing the first four (4) field programmed telephone numbers which may consist of two (2) to sixteen (16) digits. A keyboard shall remain in operation during reprogramming of telephone numbers.

The voice message shall be electronically synthesized and programmed prior to the installation in sufficiently clear language to advise operator of the alarm status. Dialer units using motors, tapes, pick-up heads, etc., are not acceptable.

After dialing the first priority number, the system shall indicate the pump station name and alarm message. The message shall be repeated up to sixteen (16) times with the time between to allow party to acknowledge by pressing a "touch-tone" key or calling in. After acknowledgement the system shall vocalize a sign-off and hang up. After a 30-minute delay to allow for corrective action, the system shall begin the re-dial sequence at one (1) minute intervals if corrective action has not been taken. Should other alarm conditions occur during the delay, the system shall re-dial the numbers in order of priority until a party is reached. The system shall be capable of being called to check the alarm status at the station.

If the first priority party is not reached, the system shall hang up, wait 60 seconds, and dial the second priority number. If no party is reached after dialing all four (4) numbers in order of priority, the system shall return to the first priority number and repeat the sequence indefinitely.

The system shall operate from a 120 VAC source with continuously float charged batteries capable of 24 hours standby operating during power outages. The operating temperature range shall be -20C to +50C.

Alarm contacts to the system shall be provided through Standard AC wire from various locations in the pump station. Contacts shall be rated 120 VAC, 1 AMP resistive.

**D. Alarm Conditions:**

The following alarm conditions shall be monitored at the pump station. The fault conditions shall be grouped to provide four (4) alarm groups to the dialer:

<u>SUBMERSIBLE STATIONS</u>	
Fault I	Wet Well High Level
Fault II	Pump #1 Failure (Over temp/Overload/Seal Moisture)
Fault III	Pump #2 Failure (Over temp/Overload/Seal Moisture)
Fault IV	Failure to Pump
Fault V	Power Failure
Fault VI	Running on Generator
Fault VII	Generator Failure

**E. Manufacturer:**

The automatic alarm dialer system shall be equal in all respects to the ADAS System by Butler National Corp. or Capital Controls Company, inc. – Advance Series 1520 (Autocon or InstraLogic systems may also be considered).

**F. Installation:**

1. For Submersible Pump Installations – The system shall be housed in a heavy gauge, UL listed steel cabinet painted with epoxy or baked-on enamel paint or fiberglass, NEMA 4.

The unit shall be mounted adjacent to the control panel in the control building.

**SECTION 300.4 STANDBY POWER GENERATOR SYSTEM**

**A. General:**

Pump stations shall have an automatic standby power generation system conforming to these specifications.

The system shall consist of a propane (0% butane) fueled standby generator in a weatherproof enclosure complete with all equipment and accessories required to automatically supply power to the pump station during a utility power failure. The engine generator set shall start the two wastewater pumps in sequence and will run both simultaneously under full load. Simultaneous starting is not required.

Diesel fueled generators may be considered on large installations (greater than 50 KW). Units 50 KW and smaller shall be propane fueled.

The generator shall include a timer that automatically exercises the generator at least once per week for 30 minutes.

**B. Engine:**

The engine shall have the following features:

1. Engine shall be propane fueled, 4 cycle. Engine speed shall be 1800 rpm.
2. Engine shall be liquid cooled and shall have a radiator, coolant pump, thermostat and fan. Air-cooled engines may be approved by the County for installation of less than 10kw.
3. Fuel system shall be for gaseous propane.
4. Governor shall be mechanical flyweight type with a speed regulation of 5 percent maximum.
5. Lubrication shall be by a positive displacement lube oil pump with positive pressure lubrication to all bearings. Full flow lube oil filter shall be provided.
6. Starting system shall be 12 volt, positive shift gear engaging starter.
7. Battery charging alternator shall be belt driven, 12 volts, 35 amps with solid-state voltage regulator. A battery float charger shall be provided.
8. An engine block heater shall be provided with control thermostat. The unit shall be 120 volt.

**C. Alternator:**

The alternator shall have the following features:

1. Alternator shall be revolving field, broad range, brushless type designed for minimum resistance, low voltage, waveform distortion,

and maximum efficiency. Rotor shall be dynamically balanced permanently aligned to engine by flexible disc coupling. Maximum allowable voltage dip shall be 30%.

2. Exciter shall be 3 phase, full wave rectified with silicon diodes mounted on a common motor shaft, sized for maximum motor starting.
3. Voltage regulator shall be solid state with silicon-controlled rectifiers with phase controlled sensing circuits.
4. Temperature rise at rated load shall be within limits for class F insulation in accordance with NEMA MG 1-22.40.
5. Insulation system shall be Class F in accordance with NEMA MG1-1.65. Rotor shall be vacuum impregnated with 100% solid epoxy resin for complete environmental protection. Stator shall be impregnated twice with varnish conforming to MIL-I-24092, Type M, Class 155.
6. Output circuit breaker shall be 3-pole, rated at 145% of alternator full load current.

**D. Unit Performance:**

Frequency regulation of the generator unit shall be 3 hertz maximum, no load to rated load.

Voltage regulation shall be plus or minus 2 percent, no load to rated load. Voltage drop during motor starting shall not prevent the successful starting of the pump motors in the pump station.

**E. Control Panel:**

A unit mounted control console shall be furnished with the following items, completely wired and installed:

1. Engine start/stop controls
2. Run/Stop Remote Switch
3. Remote start/stop terminals for 2-wire starting from automatic switch
4. Oil pressure gauge
5. Coolant temperature gauge
6. Charge rate ammeter

7. Overcrank protection and alarm light
8. Low Pressure shutdown and alarm light
9. High coolant temperature shutdown and alarm light
10. Overspeed shutdown and alarm light
11. AC voltmeter and selector switch
12. AC ammeter and selector switch
13. Voltage adjusting rheostat
14. Running time meter
15. Exciter circuit breaker, manual reset
16. Alarm contact for automatic dialer (generator fail signal).

**F. Accessories:**

All accessories needed for the proper operation of the generating set shall be furnished and installed. These shall include, but are not limited to, the following:

1. Muffler with residential silencing
2. Flexible exhaust connection
3. Exhaust pipe
4. Starting batteries
5. Battery cables
6. Battery rack (inside weatherproof enclosure)
7. Battery float charger
8. Propane tanks, pressure regulator, air and fuel filters, valves and piping
9. Flexible fuel line connections to the engine

**G. Weatherproof Enclosure:**

The generator control panel, batteries and battery charger shall be installed in a weatherproof enclosure.

The weatherproof enclosure shall be welded reinforced sheet steel, 14 gauge, prime coated and finished painted, and shall have hinged or lift-off doors for access to the generator set and all other equipment inside.

**H. Gaseous Fuel System:**

All equipment and piping for the propane fuel system shall be furnished and installed. The fuel system shall conform to NFPA 58.

1. **Fuel Tank** – above ground tank sized to ensure starting and running of the generator set under full load for a period of not less than twenty four (24) hours, or longer if required by State regulatory authorities, at an ambient temperature of 20 degrees F. Design pressure rating shall not be less than 250 psig.
2. **Fuel Piping** – shall comply with NFPA 58 for a design working pressure of 250 psig. Pipe size shall be per manufacturer's recommendations, but not less than ½ inch. Cast iron pipe and fittings shall not be used.
3. **Vapor Withdrawal System** – shall include a manual shut-off valve at the tank(s) a vaporizer, dry fuel filter, line service regulator, solenoid fuel shut-off valve to open when engine runs, flexible pipe connection at the engine, and a gas flow regulator.

**I. Fuel, Antifreeze, & Oil:**

An 80% charge of propane in the propane storage tank shall be provided at the time of final acceptance by the County.

Complete charges of antifreeze and oil shall be provided.

**J. Tests:**

After installation of the engine generator set is complete, and prior to its acceptance by the County, the supplier shall demonstrate the capability of the system to perform in accordance with these specifications to the satisfaction of the County.

A 4-hour load bank test shall be performed to load the generator set to the alternator KW rating 1.0 power factor. The test shall be witnessed by the County.

Any defects which become evident during this test shall be corrected.

Safety shutdown features shall be tested by simulating the primary device contact closure.

**K. Manufacturer:**

The standby power generator set shall be ONAN, KOHLER, CATERPILLAR, GENERAC or equal.

**L. Parts and Service:**

The generator set, controls, and transfer switch shall be furnished by a single supplier.

The engine-generator set supplier shall be the authorized dealer of the engine-generator set manufacturer, and shall be fully qualified and authorized to provide service and parts for the engine and generator at any time during the day or night. Parts and service shall be available twenty-four (24) hours per day, seven (7) days a week, from a location within a 100-mile radius of the location of the installed generator set.

**M. Automatic Transfer Switch:**

The transfer switch, supplied as part of the standby power supply, shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a non-ventilated enclosure constructed in accordance with Underwriter's Laboratories, Inc., Standard UL-508.

The transfer switch shall be double throw actuated by a single electrical operator momentarily energized and connected to the transfer mechanism by a simple overcenter type linkage with a total transfer time not to exceed ½ second. The transfer switch shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.

The transfer switches shall be double throw, actuated by two (2) electrical operators momentarily energized and connected to the transfer mechanism by a simple overcenter linkage with a minimum transfer time of 25 hertz, or longer if so specified. The time delay between the opening of the closed contacts and the closing of the open contacts is to allow the loads to be demagnetized before transfer. This type transfer switch shall allow the motor and transfer loads to be re-energized after transfer with normal inrush current.

The normal and standby contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing.

Main contacts shall be mechanically locked in position in both the normal and standby positions without the use of hooks, latches, magnets, or springs, and shall be silver tungsten alloy-protected by arching contacts, with magnetic blow-outs on each pole. Interlocked molded case circuit breakers are not acceptable.

The transfer switch shall be equipped with a manual operator that is designed to prevent injury to the operating personnel if the electrical operator should suddenly

become energized during manual transfer. The manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

In addition to the above, the transfer switch must have a short circuit with capability in excess of the UL minimum requirements as follows:

100 – 150 amperes	16,000 RMS amperes symmetrical
225 amperes	20,000 RMS amperes symmetrical
400 – 800 amperes	40,000 RMS amperes symmetrical
1000 – 1600 amperes	50,000 RMS amperes symmetrical
2000 – 3000 amperes	73,000 RMS amperes symmetrical

Engine starting contacts shall be provided to start the generating plant if any phase of the normal source drops below 80% of rated voltage, after an adjustable time delay period of 3 seconds to allow for momentary dips. The transfer switch shall transfer to standby as soon as the voltage and frequency have reached 90% of rated voltage. After restoration of normal power on all phases to 90% of rated voltage, an adjustable time-delay period of 0-30 minutes shall delay retransfer to normal power until it has had time to stabilize. If the standby power source should fail during the time delay period, the time delay shall be bypassed, and the switch shall return immediately to the normal source. After the switch has retransferred to normal, the engine generator shall be allowed to operate at no load for an adjustable period of time (0-15 minutes) to allow it to cool before shutdown. The transfer switch shall include a test switch to simulate normal power failure, pilot lights on the cabinet door to indicate the switch closed normal or standby, and two (2) auxiliary contacts on the main shaft, one (1) closed on normal, the other closed on emergency. In addition, one (1) set of relay contacts shall be provided to open on loss of the normal power supply. All relays, times, control wiring and accessories shall be front accessible.

As a pre-condition for approval, all transfer switches, complete with timers, relays and accessories shall be listed by Underwriter's Laboratories, Inc. in the Electrical Construction Materials Catalogue under Standard UL-1008 (automatic transfer switches) and approved for use on Emergency Systems.

**N. Operating Instructions:**

Six (6) complete copies of operating instructions and parts lists shall be provided prior to acceptance of the unit. Parts list shall include schedule of type and quantity of parts recommended for stock.

**O. Warranty:**

The complete standby power generating system shall be warranted for one year after the acceptance of the generating system by the County. The warranty shall cover all defects in equipment, parts, assembly, and installation. The warranty shall be issued in writing by the supplier and delivered to the Department of Public Works.

## **SECTION 300.5 FORCE MAIN MATERIALS**

### **A. General:**

Force mains shall be constructed of ductile iron or PVC pipe as specified herein. PVC pipe shall be installed with a metallic locator tape installed directly over the force main at a depth of 18 inches below finished grade.

Force mains from pumping stations which are to be maintained by the County of Botetourt shall not be less than 4-inch nominal diameter, so as to convey a 3-inch solid which may be passed by a non-clog solids handling wastewater pump. Temporary force mains that may connect to grinder pump stations, where permitted by the County, may be 3-inch or smaller in size.

At pumping capacity, a minimum velocity of two feet per second shall be maintained. Maximum velocity shall be eight feet per second.

An automatic air relief shall be placed at the necessary high points in the force main to release trapped air. Efforts shall be made in force main routing to minimize or eliminate high points.

Force mains shall terminate in manholes with its centerline elevation set as to ensure a smooth transition to gravity flow. The design shall be such as to prevent turbulence.

Private force mains shall connect to a cleanout with a drop stack connection at the right-of-way or easement line. From there the flow shall be gravity into the public system. See Detail Drawings.

All pipe used for force mains shall be pressure type with pressure type joints. (PVC SDR 21, CL 600 minimal)

Anchorage/thrust restraints shall be provided where deemed necessary by the County, refer to the Commonwealth of Virginia Sewerage Regulations for testing and anchorage guidelines of force main sewers.

Receiving gravity flow sewage system shall be analyzed for adequacy to handle peak force main discharges.

Locator wire shall be installed with all force main PVC pipe. Refer to Detail Drawings. Minimum U.S. standard gauge 10 solid copper. County may require heavier gauge wire in depths of greater than 6'.

**B. Ductile Iron Pipe:**

All ductile iron pipe shall be designed as per AWWA Standard C150 for a working pressure of 150 psi, laying condition 1. Pipe shall be manufactured in accordance with all applicable requirements of AWWA Standard C151.

Pipe joints shall be of the push-on type as per AWWA Standard C111. Pipe lining shall be cement mortar with a seal coat of bituminous material, all in accordance with AWWA Standard C104.

Ductile iron pipe shall be as manufactured by Griffin, U.S. Pipe, American, or Clow. The pipe shall be furnished in 18-foot or 20-foot lengths.

**C. PVC Pipe – 4-Inch & Larger:**

Polyvinyl Chloride (PVC) pressure pipe 4 inches and larger shall meet the requirements of AWWA C900 “Standard for PVC Pressure Pipe, 4-Inch through 12-Inch” for pressure class 150. PVC Pressure Pipe may be used for the force main except where ductile iron pipe is specifically required on the approved plan. The PVC pressure pipe shall be furnished in ductile iron pipe equivalent outside diameters. Laying length shall be 20 feet nominal. Each length of PVC pipe shall be factory tested hydrostatically to 600 psi for 5 seconds.

Pipe joints shall be of the bell and spigot type utilizing a rubber ring elastomeric bell joint which shall be an integral and homogenous part of the pipe barrel.

PVC C900 pipe shall be as manufactured by Johns-Manville, Clow, Robin-Tech or approved equal.

**D. PVC Pipe – 3-Inch & Smaller:**

Unless otherwise shown on the approved plans, small diameter PVC pipe shall be Class 200, SDR 21, conforming to ASTM Designation D-2241. Joints for pressure rated PVC pipe may be of the rubber ring, bell joint type, where the bell is an integral and homogenous part of the pipe barrel. The basic pipe material shall meet the requirements for Type 1, Grade 1, for PVC 1120 of the ASTM Resin Specification D-1784.

Pressure-rated PVC, Class 200, shall be as manufactured by Johns-Manville, Clow, Robin-Tech or approved equal.

**SECTION 300.6 FORCE MAIN – INSTALLATION METHODS**

**A. General Requirements:**

All force main construction methods, including trench excavation, bedding, backfill, etc. shall conform to the Virginia Department of Environmental Quality standards. Thrust blocks shall be placed at all bends, elbows and appurtenances.

The engineering drawings for all force mains shall include a profile drawing for the entire length of the main. Sewer air valves and/or air and vacuum valves shall be installed at all high points on the force main.

**B. Testing of Force Mains:**

Sewer force mains shall be hydrostatically tested at 150% of the design operating pressure or a minimum pressure of 50 psi for 30 minutes. Allowable leakage shall be the same as established for water pipe lines in the Botetourt County Water and Sewer Standard and Specifications and as per AWWA C600.

**END OF STANDARD SPECIFICATIONS**